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Assessment of the cod stock in Subdivision 3Ps

by

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Abstract

Cod catches from Subdiv. 3Ps were lower in 1982 than in 1980 and 1981 mainly because of a substantially decreased catch by the line trawl gear component. Age compositions of samples from the commercial fishery and research vessel surveys indicated that the 1978 year class was strong while that for 1979 was weak. Regression analysis of catch rate indices and population biomass from cohort analyses estimated the fully recruited fishery mortality in 1982 as 0.45. The numbers of fish in year classes recruiting to the fishery in recent years have been below a long term geometric mean estimated from cohort analyses. The projected $F_{0.1}$ catch in 1984 was 21,000 t which would increase to 30,000 t by 1986.

Résumé

Les prises de morue de la subdiv. 3Ps ont été plus faibles en 1982 qu'en 1980 et 1981, en grande partie par suite d'une substantielle diminution des prises à la palangre dans cette région. La composition par âge d'échantillons de pêche commerciale et de relevés des navires de recherche indique que la classe d'âge de 1978 était forte mais que celle de 1979 était faible. Une analyse de régression des indices de taux de capture et la biomasse de population découlant d'analyses des cohortes ont permis d'estimer à 0,45 la mortalité des individus pleinement recrutés à la pêche en 1982. Les effectifs des classes d'âge qui ont rallié le stock pêchable ces dernières années ont été inférieurs à la moyenne géométrique à long terme, estimée par analyses des cohortes. Les prédictions de prises à $F_{0.1}$ en 1984 sont de 21 000 t, et elles augmenteraient pour atteindre 30 000 t en 1986.

103-01527

Nominal catch and catch at age

Cod catches from Subdivision 3Ps since 1975 along with corresponding TAC's are as follows:

	1975	1976	1977	1978	1979	1980	1981	1982	1983
TAC('000t)	62.4	47.5	32.5	25	25	28	30	33	33
Catch('000t)	35	37	32	27	33	38	39	32[a]	

[a]:preliminary

Canadian landings in 1982 by month and gear are shown in Table 1. Total cod landings for the period 1959-82 are shown in Fig. 1 along with a breakdown of the Can (N) inshore catch by gear for the period 1964-82 in Fig. 2.

The majority of the total catch was from the offshore fleet (otter trawl) until the mid 1970's. Since 1977 the only countries involved in this fishery have been Canada and France. Because of restrictions on the offshore allocations, inshore catches have been making up the larger portion of the total since approximately 1978. Inshore catches showed a general increase from 1975 to 1980 but have since declined, particularly in 1982. Some major influences in recent years have been the consistently low level of codtrap catch and the rapid increase in linetrawl catch since 1976 followed by the

sharp decline for this gear in 1982. Catch at age data for the commercial fishery in 1982 were obtained using sampling data as shown in Table 2. Catch information was not available for France and the total catch was assumed to be equal to the allocation of 5,170 t.

Age frequencies for the major gear components in the fishery are shown in Table 3 while the estimated catch at age with associated variance is indicated in Table 4. Average weights at age (Table 4) were obtained by applying a length-weight relationship (log weight = log length X 3.0879 -5.2106) to the length frequencies and age length keys. The calculated total catch weight was found to be 0.5% greater than that reported. From Table 4 and Fig. 3 it can be seen that the 1978 and 77 year classes were most abundant. The 1976 year class once again appears to be weak while the 1974 and 75 year classes continue to show strength. The presence of a weak 1976 year class and strong 1974 and 1975 year classes is in agreement with results presented in the 1982 assessment (Bishop and Gavaris, 1982).

Survey Data

The results from a stratified random research survey in 1982 were tabulated with those from previous surveys and are shown in Tables 5 and 6. In calculating the mean number per tow (Table 6) strata were combined on the basis of depth zone (50-200 fath) and strata on Burgeo Bank (strata 306-309) were excluded, as was done previously (Bishop and Gavaris, 1982). The age

distribution obtained (Table 6, Fig. 3) is similar to that observed in the commercial fishery for ages 3 and older. There are also indications that the 1980 and 81 year classes are near or above average in strength. Fig. 4 shows the total mean number per tow per year along with associated confidence limits. Table 5 shows the biomass estimates by depth zone for all strata surveyed from 1972-1982.

Catch-effort data

Catch rate data for Canada (Newfoundland), Spain, and Portugal were analyzed using a multiplicative model. Canada (Maritimes) data were not included due to suspected problems with that information. Data for 1959-80 were obtained from ICNAF/NAFO Statistical Bulletins while data for 1981-82 were provided by the Statistics and Systems Branch, DFO. Similar to previous work (Bishop and Gavaris 1982) the data were analyzed as two time periods, 1959-77 and 1977-82. Weighting factors for the observations used in the regressions were estimated from the residuals (Judge et al. 1980, p. 132). For both time periods a strong seasonal trend was indicated (Tables 7 and 8) with catch rates being highest in the winter. The annual catch rate indices (Table 9, Fig. 5) show an increasing trend since the mid 70's but the variances for this period are large, partly due to the small amount of data available for catch rate analysis.

Cohort analysis

Catch and weight at age data from the 1982 commercial fishery (Table 4) were added to previously used matrices as indicated in Table 10. These data were used in a cohort analysis having a partial recruitment equal to that presented in the 1982 assessment (Bishop and Gavaris 1982) and with fishing mortalities at age 14 (F_t) estimated as the fully recruited fishing mortality for ages 7 to 11. From trial runs of the cohort using different values of (F_t), the selection pattern estimated as appropriate for 1982 was the average of selectivity coefficients over the years 1978-80 from a cohort with F_t=0.45 (Tables 12-13). The selectivities (Table 14) were obtained by dividing the fishing mortalities by weighted F over ages 7 to 11. The F's were weighted by the population numbers (Table 11) for the same ages.

Because of changed fishing patterns in recent years (mainly an inshore fishery since 1977), it was considered inappropriate to determine a suitable value for the terminal F in 1982 by using the relationship of exploitable biomass available to the total fishery during this period with catch rate indices from the offshore fishery. These indices relate to a small portion of the fishery for which the selectivity might differ from that of inshore gears.

To obtain a more realistic relationship between catch rate and exploitable biomass, the fishing mortality from the offshore portion of the fishery was estimated. This was accomplished by multiplying the fishing mortality from the

total fishery by the proportion of the catch taken offshore for 1978-82 (Table 15).

It was assumed that the catch up to 1977 was mainly from the offshore. The resulting F's and selectivities (calculated as stated earlier) are shown in Table 15. Using these selectivities the 'offshore' exploitable biomass was estimated. Regression analyses of 'offshore' exploitable population biomasses with catch rate indices were used to obtain an estimate of F_t in 1982. Table 16 shows the results obtained from cohorts at F_t=0.35, 0.40, 0.45, and 0.50. Data were used for the period 1961-82 because of the inconsistency of the 1959 and 60 catch rate values with population biomass estimates.

The best 'fit' of catch rate indices to 'offshore' biomass with respect to the intercept was with a F_t between 0.40 and 0.45. While the r^2 values indicated a peak at the 0.45 level of F_t it can be seen that the r^2 showed little variation over the range of F_t values presented. Also considered were the trends of the residual values in recent years (Table 16). The cohort with F_t=0.45 produced a spread of positive and negative residuals about the fitted line (Fig. 6) over the period 1979-81. The confidence limits about the indices in recent years are large (Fig. 5) and there is some indication (Table 17) that the 1982 value may be high.

Recruitment

From the relationships of mean number per tow at ages 2 and 3 with cohort numbers at age 3 (F_t=0.45) estimates of the strengths of the 1978-80 year classes were obtained (Table 18; Fig. 7). A comparison of cohort recruitment estimates at age 3 by year with the geometric mean of cohort recruitment for the period 1959-81 is shown in Fig. 8. As indicated, year class strength in recent years had been generally below the long term geometric mean.

Projections

Catch projections (Tables 20 and 21) were constructed using data as shown in Table 19. Population numbers for 1982 were obtained from the cohort run at F_t=0.45. The population number at age 3 from this run was considered low, probably the result of sampling deficiencies, and as such was estimated (Table 18) to approximate 30 million. The strength of the 1980 year class at age 3 was estimated as 45 million while that for 1981-83 were assigned a value of 55 million, an approximation of the long term geometric mean recruitment.

REFERENCES

Bishop, C.A. and S. Gavaris. 1982. Status of the cod stock in Subdivision 3Ps. CAFSAC Res. Doc. 82/33.

Judge, G.G., W.E. Griffiths, R.C. Hill, and T.C. Lee. 1980. The theory and practice of econometrics. John Willey and Sons, New York. 793 p.

Table 1. Cod landings in 1982(t) from Subdivision 3Ps by month and gear.

Month	OT	Trap	GN	Can(N) LT	HL	DS	PT	Total
January	22		30	320	3			375
February	294		4	517	13			828
March	357		64	1100	7			1528
April	907		294	697	6			1904
May	358	109	1460	900	151	2	2	2982
June	27	1224	1694	1704	483	2	11	5145
July	8	603	1728	1072	405	1	14	3831
August	12	4	695	1979	382	2	9	3083
September	9		182	1615	150	6		1962
October	51		78	553	36			718
November	353		22	358	20	3		756
December	198		24	190	10			422
TOTAL	2596	1940	6275	11005	1666	16	36	23,534

Month	Can(M) OT	LL	Total
January	29		29
February			
March	414		414
April	274	41	315
May	81	67	148
June	11	41	52
July		418	418
August		794	794
September	16	274	290
October	26	370	396
November	1	20	21
December	62	6	68
TOTAL	914	2031	2945

France

Information available for inshore fishery only. Allocation = 5,170t (4322OT + 848 inshore).

Table 2. Commercial sampling for Subdivision 3Ps cod in 1982.

Qtr.	Gear	Country	# Aged	Month	# Measured	Landings Country/Month	Landings Total
1	OT	Can N	354	January	361	22	1116
				March	2094	357	
	LT	Can N	348	February	2562	517	837
2	OT	Can N	242	April	238	907	1675
				May	4273	358	
	LT	Can N	736	March	2945	1100	2697
				April	207	697	
				May	1984	900	
	GN	Can N		May	3552	1460	1852
3	OT	Can N	67	August	502	12	77
	LT	Can N	819	June	954	1704	4755
				July	2173	1072	
				August	4945	1979	
		Can M		August	364	794	2031
	GN	Can N		June	2411	1694	4423
				July	719	1728	
	Trap	Can N		June	3975	1224	1940
				July	503	603	
	HL	Can N		June	283	483	1666
				July	420	405	
4	OT	Can N	311	November	2158	353	694
	LT	Can N	745	September	2962	1615	2716
				October	1630	553	
				November	926	358	
Totals			3,622		43,141		26,479

The estimated catch by France (5,170t) was converted to #s at age based on the above sampling.

Table 3. Cod catch at age and by gear from the Canadian fishery in Subdivision 3Ps during 1982.

Age	OT Can.	LT Can.(N)	LT Can.(M)	GN	Trap	HL	Total Can.
2		3					3
3	1	29			53	2	85
4	142	1378	7	113	1679	665	3984
5	270	1454	36	382	629	469	3240
6	243	683	54	400	80	110	1570
7	345	950	121	676	44	92	2228
8	295	1015	183	857	22	80	2452
9	59	225	84	182	4	19	573
10	18	97	46	66	1	5	233
11	10	30	16	23		2	81
12		14	6	6			26
13		5	2	3			10
14	1	3	2	1			7
15		3		1			4
16		2	1				3
17			1				1
18		1					1
Landings	3,562	11,005	2,031	6,275	1,940	1,666	26,479

Table 4. Estimates of catch and weight at age of Subdivision 3Ps cod from the commercial fishery in 1982.

AGE	WEIGHT (kg)	LENGTH (cm)	CATCH (Nos)X10^{-3}	VAR(CATCH)	STD.ERROR	COEF.VAR
2	0.346	34.435	4	5.337	2.31	0.61
3	0.450	37.441	104	784.348	28.01	0.27
4	0.773	44.223	4807	41155.644	202.87	0.04
5	1.173	50.527	3893	49397.403	222.26	0.06
6	1.782	58.226	1873	19833.984	140.83	0.08
7	2.360	63.614	2656	20205.284	142.15	0.05
8	2.879	67.794	2935	16497.865	128.44	0.04
9	3.908	74.426	686	4047.141	63.62	0.09
10	5.282	81.655	281	1185.648	34.43	0.12
11	6.180	85.607	97	501.173	22.39	0.23
12	8.616	96.386	32	38.752	6.23	0.19
13	8.639	96.718	14	15.322	3.91	0.29
14	11.406	106.273	9	9.060	3.01	0.33
15	14.075	113.819	4	2.655	1.63	0.39
16	13.365	111.724	4	4.115	2.03	0.46
17	10.328	101.200	2	2.352	1.53	0.86
18	14.454	115.618	1	1.363	1.17	0.89
19						
20	19.308	127.000				0.01

Table 5. Cod biomass (T) from stratified random cruises in Subdivision 3Ps

Depth Range(Fm.)	Strata	Area	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0-30	314	974	0	-	1328	-	2357	249	0	-	432	369	2028
	320	1320	-	729	-	-	1335	-	-	-	2946	23087	1920
TOTAL			0	729	1328	-	3692	249	0	-	3378	23456	3948
31-50	308	112	-	181	279	205	193	311	38	125	240	305	490
	312	272	210	-	243	355	456	1047	343	151	-	165	766
	315	827	1480	0	592	0	1747	1550	-	1836	235	0	528
	321	1189	1917	0	-	-	1742	-	2037	-	1880	1419	2845
	325	944	-	-	-	-	2	-	180	820	28	1109	85
	326	166	-	-	-	-	-	-	0	2	3	0	54
TOTAL			3607	181	1114	540	4140	2908	2598	2934	2386	2998	4768
51-100	307	395	2918	6133	3919	884	1127	2097	3222	4105	1763	13723	3028
	311	317	3885	590	2432	763	627	411	154	1106	3792	761	1943
	317	193	101	286	589	164	551	491	-	368	536	268	1582
	319	984	4604	662	478	481	3102	2493	-	10637	1652	15068	3548
	322	1567	-	-	-	-	5183	-	491	14	2599	26	3705
	323	696	736	-	-	-	368	63	1652	-	775	491	1215
	324	494	-	-	-	-	8	-	-	29	0	-	430
TOTAL			12244	7671	7418	2292	10966	5555	5519	16259	11117	30337	15451
101-151	306	419	-	-	376	719	214	161	416	710	457	2652	1211
	309	296	662	975	479	311	178	192	103	1558	863	2983	838
	310	170	1008	191	377	2183	-	0	154	119	0	817	608
	313	165	371	29	144	242	142	41	50	1036	127	446	283
	316	189	271	937	63	58	77	17	-	65	61	25	-
	318	123	173	11	4	0	0	6	-	36	790	-	136
TOTAL			2485	2143	1443	3513	611	417	723	3524	2298	6923	3076
151-200	705	195	-	-	66	0	0	60	1	91	674	1310	22
	706	476	-	-	23	-	-	76	-	356	827	304	30
	707	93	-	-	5	0	0	228	-	326	190	-	-
	715	132	-	-	-	1	1	31	142	352	499	168	154
	716	539	-	-	-	-	-	92	781	303	248	1608	168
TOTAL					94	1	1	487	924	1428	2438	3390	374
201-300	708	117	-	-	-	0	-	11	-	177	4633	-	-
	711	961	-	-	-	-	-	-	-	-	1113	0	0
	712	973	-	-	-	-	-	-	-	9077	282	259	353
	713	950	-	-	-	0	-	-	-	-	0	850	0
	714	1195	-	-	-	-	-	-	-	-	0	161	0
TOTAL			-	-	-	0	-	11	-	9254	6028	1270	353

	Total Area per Depth Range				
0-30	2294	-	3378	23456	3948
31-50	3510	2934	2386	2998	4768
51-100	4646	16259	11117	30337	15451
101-150	1362	3524	2298	6923	3076
151-200	1435	1428	2438	3390	374
201-300	4196	9254	6028	1270	353
TOTAL		33399	27645	68374	27970

Table 6. Mean number of cod per tow from research trips in Subdivision 3Ps (stratification by depth zone - 50 to 200 fath and excluding strata on Burgeo Bank - 306 to 309).

Age	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.07	.15	1.33	1.06	0.31	.03	0.0	3.60	.23	.08	1.31
2	1.83	3.96	6.45	1.72	5.35	.26	1.06	1.89	9.57	1.50	2.35
3	3.35	2.39	4.70	5.18	3.30	4.57	.88	1.40	3.22	5.94	.61
4	4.86	3.13	2.04	4.93	4.97	4.26	3.46	6.15	1.09	5.35	6.71
5	2.41	1.54	2.36	2.42	2.07	3.82	1.51	13.84	3.06	5.79	3.08
6	1.38	.21	2.79	2.07	.79	.93	.76	1.98	2.51	4.63	1.47
7	1.97	.28	.93	1.70	.50	.24	.44	.72	.57	3.11	2.11
8	1.37	.08	.73	.53	.50	.25	.35	.49	.62	.46	2.17
9	.67	.10	.63	.40	.12	.40	.20	.26	.21	.58	.60
10	.47	.06	.26	.21	.07	.16	.21	.20	.17	.15	.11
11	.21	.02	.12	.06	.05	.01	.07	.07	.12	.06	.07
12	.12	.02	.07	.02	.05	.06	.02	.05	.14	.08	.03
13	.07	.02	.06	.06		.05	.02	.02	.05	.07	.02
14	.15		.06			.02	.00	.04	.00	.06	.02
15	.07			.02	.05	.03	.02		.03		.04
16	.17	.02	.01						.02		.04
17	.17	.04	.01	.04					.02		
18	.08	.06	.01								
19	.02				.03						
20	.02			.01		.03					
>20	.01	.03	.01				.04				
Total	19.48	12.11	22.57	20.43	18.18	15.11	9.04	30.70	21.63	27.85	20.73
Confidence Limits											
Upper	33.98	18.89	33.25	34.09	25.25	21.58	13.26	61.63	31.75	60.09	30.45
Lower	4.98	5.33	11.90	6.76	11.12	8.64	4.82	-0.24	11.51	-4.39	11.01
Sets	37	43	59	38	53	74	30	55	55	36	70
Survey dates	March 20-30	March 16-23	April 19-30	June 2-13	May 11-21	April 14-26	Feb. 21-28	Feb.16 March 5	Mar.19 April 2	March 7-26	May 28 June 09

Table 7. Regression coefficients for grouped categories and the analysis of variance from the regression of ln catch rate for cod in Subdivision 3Ps from 1959-77.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.711
MULTIPLE R SQUARED.....0.506

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	3.193E1	3.193E1	
REGRESSION	28	1.715E2	6.126E0	23.381
TYPE 1	3	1.064E2	3.547E1	135.382
TYPE 2	7	7.864E1	1.123E1	42.881
TYPE 3	18	5.033E1	2.796E0	10.672
RESIDUALS	639	1.674E2	2.620E-1	
TOTAL	668	3.709E2		

Country	Gear	ln power
Can(N)	OT-4	0.000
Can(N)	OT-5	
Span	OT-6	0.511
Port	OT-6	
Span	PT-4	0.892
Span	PT-6	
Span	PT-5	1.254

Month	ln power
July	-0.671
June	
August	-0.608
September	-0.516
October	
May	-0.440
November	-0.557
April	
December	-0.212
March	-0.097
January	
February	0.000

Table 8. Regression coefficients for grouped categories and the analysis of variance from the regression of ln catch rate for cod in Subdivision 3Ps from 1977-82.

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R.....0.570
MULTIPLE R SQUARED.....0.325

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.619E2	1.619E2	
REGRESSION	14	2.307E1	1.648E0	3.684
TYPE 1	1	7.010E0	7.010E0	15.677
TYPE 2	8	1.750E1	2.187E0	4.891
TYPE 3	5	2.094E0	4.188E-1	0.937
RESIDUALS	107	4.785E1	4.472E-1	
TOTAL	122	2.328E2		

Country - Gear	ln Power
Can(N) OT-4	0.000
Can(N) OT-5	0.413

Month	ln power
June July August September	-1.032
October	-0.885
April	-0.696
May	-0.660
November	-0.623
March	-0.296
December	-0.263
February	-0.124
January	0.000

Table 9. Mean catch rate indices of cod in Subdivision 3Ps for years 1959-82 relative to 1977. The proportion of total catch which was used in the analysis for each year is indicated.

YEAR	TOTAL CATCH	PROP.	RELATIVE POWER MEAN	S.E.	EFFORT
1959	60170	0.023	1.766	0.287	34081
1960	72636	0.177	1.551	0.254	46820
1961	83620	0.224	2.256	0.353	37067
1962	52639	0.529	1.770	0.286	29739
1963	50051	0.261	2.259	0.370	22161
1964	53956	0.215	1.996	0.324	27038
1965	51400	0.329	2.081	0.338	24698
1966	65749	0.233	2.320	0.364	28338
1967	62393	0.462	1.917	0.311	32545
1968	77217	0.250	2.389	0.370	32324
1969	63103	0.515	2.354	0.369	26811
1970	76161	0.413	1.979	0.309	38487
1971	63967	0.609	1.981	0.308	32292
1972	44323	0.605	1.492	0.228	29713
1973	52641	0.399	1.424	0.216	36979
1974	46712	0.463	1.034	0.159	45157
1975	35373	0.508	0.976	0.160	36240
1976	37133	0.357	1.046	0.166	35489
1977	32245	0.320	1.000	0.000	32245

AVERAGE C.V. FOR THE MEAN:0.150

YEAR	TOTAL CATCH	PROP.	RELATIVE POWER MEAN	S.E.	EFFORT
1977	32245	0.044	1.000	0.000	32245
1978	27221	0.052	1.194	0.279	22789
1979	33006	0.049	1.289	0.282	25600
1980	37568	0.057	1.054	0.217	35633
1981	38905	0.040	1.315	0.289	29584
1982	31649	0.068	1.585	0.324	19964

AVERAGE C.V. FOR THE MEAN:0.180

Table 10. Catch and weight at age data for Subdivision 3Ps cod. Weights at age prior 1975 were the same as those presented for 1975 and 1976.

CATCH AT AGE 3PS ('000)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	1001	567	450	1245	961	1906	2314	949	2871	1143	774	756	2384	731	945	1887	1840	4110
4	13940	5496	5586	6749	4499	5785	9636	13662	10913	12602	7098	8114	6444	4944	4707	6642	7329	12139
5	7525	23704	10357	9003	7091	5635	5799	13065	12900	13135	11565	12916	8574	4591	11386	9887	5397	7933
6	7265	6714	15960	4533	5275	5179	3609	4621	6392	5853	7178	9763	7266	3552	4010	6366	4541	2973
7	4875	3476	3616	5715	2527	2945	3254	5119	2349	3572	4554	6374	5218	4603	4002	3540	3322	1316
8	942	3484	4680	1367	3030	1881	2055	1586	1364	1308	1567	2465	3191	2638	2291	1857	1	726
9	1252	1020	1649	791	898	1891	1213	1833	604	549	792	730	1275	833	2019	1149	1196	1402
10	1260	827	1376	571	292	652	1033	1039	316	425	717	214	541	463	515	638	105	83
11	631	406	446	187	143	339	327	517	380	222	61	178	85	205	172	249	174	211
12	545	407	265	140	99	329	68	389	95	111	120	77	125	117	110	80	57	61
13	44	283	560	135	107	54	122	32	149	5	67	121	62	48	14	32	8	4
14	0	27	58	241	92	27	36	22	3	107	110	14	57	45	29	17	2	3

AGE	1977	1978	1979	1980	1981	1982
3	935	218	149	298	1000	104
4	9156	4308	2370	1644	2765	4807
5	8326	5391	9777	5096	2864	3693
6	3209	4203	5235	8335	4220	1973
7	920	1791	2588	4387	5187	2656
8	395	730	884	1420	1573	2933
9	265	243	284	349	571	686
10	117	169	82	104	204	281
11	57	76	48	54	89	97
12	43	26	19	42	37	32
13	31	19	11	19	24	14
14	11	10	10	25	6	9

WEIGHT AT AGE (KG)

AGE	1975	1976	1977	1978	1979	1980	1981	1982
3	0.280	0.280	0.550	0.450	0.410	0.520	0.480	0.450
4	0.690	0.690	0.680	0.700	0.650	0.720	0.790	0.770
5	1.080	1.080	1.300	1.080	1.010	1.130	1.320	1.170
6	1.680	1.680	1.860	1.750	1.650	1.660	1.800	1.780
7	2.400	2.400	2.670	2.450	2.350	2.480	2.300	2.360
8	3.210	3.210	3.420	2.990	3.680	3.600	3.270	2.880
9	4.100	4.100	4.190	4.100	4.300	5.400	4.360	3.910
10	5.080	5.080	4.940	5.160	6.490	6.950	5.680	5.280
11	6.030	6.030	5.920	5.170	7.000	7.290	7.410	6.180
12	7.000	7.000	6.760	7.200	8.200	8.640	9.040	8.620
13	8.050	8.050	8.780	7.750	9.530	9.330	8.390	8.640
14	9.160	9.160	10.900	8.720	10.840	9.580	9.560	11.410

Table 11. Population Numbers (X 10^{-3}) of Subdivision 3Ps cod from a cohort run at F_t = 0.45.

POPULATION NUMBERS

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	59382	59262	50953	48678	42961	70840	80988	84422	98486	70191	54370	35485	60173	39283	30924
4	107059	47716	48007	41310	38728	34304	56274	64214	68260	78036	56433	43814	28368	46856	31501
5	35832	75039	34094	34250	27715	27637	22951	37354	40212	46012	52487	39781	28530	17395	33725
6	24206	25529	39989	18542	19895	16275	17528	13462	18761	21250	25787	32491	20883	15600	10068
7	16270	13245	12369	18299	11079	11516	8638	11065	6841	9577	12102	14617	17767	10523	9558
8	5813	8910	7699	6855	9811	6785	6764	4128	4444	3475	4609	5768	6200	7110	4451
9	4041	3907	4142	2068	4375	5291	3853	3678	1945	2404	1662	2183	2516	2243	3436
10	3439	2176	2276	1718	978	2770	2620	2052	1353	1046	1472	644	1127	707	1083
11	3661	1675	1033	618	890	536	1678	1211	740	822	472	556	333	433	323
12	1181	2426	1004	442	337	599	132	1078	523	262	472	331	294	196	169
13	158	474	1618	582	235	186	193	47	530	343	114	278	201	128	55
14	0	90	132	818	355	96	104	48	9	299	276	33	115	109	61
3+	261047	237447	203315	174181	157360	176834	201624	222779	242105	233717	210255	176000	166512	140584	125375
4+	201660	178185	152362	125503	114398	105994	120636	138357	143619	163526	155885	140516	106339	101301	94451
5+	94600	130469	104355	84194	75670	71690	64362	74143	75359	85490	99452	96702	77971	54645	62950
6+	58769	55429	70261	49943	47956	44053	41510	36789	35147	39478	46965	56921	49441	37250	29225
7+	34563	32902	30273	31401	28060	27779	23982	23327	16386	18228	21178	24430	28558	21649	19157

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	42211	56781	58731	76622	38204	20801	37557	88953	12805
4	24464	32852	44823	44366	61887	31082	16896	30480	71924
5	21532	14562	20266	25714	28039	46770	23303	12346	22453
6	17309	8592	7039	9423	13519	18078	29446	14468	7516
7	4631	8412	2926	3162	4811	7266	10065	16566	8027
8	4187	1493	1579	1215	1756	2319	3607	4271	6870
9	1652	1747	568	845	637	777	1098	1668	2073
10	987	313	348	339	452	302	379	584	849
11	421	321	161	237	171	199	173	216	293
12	109	119	105	117	143	72	119	93	97
13	39	17	50	67	57	93	41	60	42
14	32	3	8	38	27	29	66	17	27
3+	117573	125213	136605	162143	149703	127788	122751	169720	134976
4+	75362	68432	77875	85522	111499	106986	85194	80767	122171
5+	50898	35580	33051	41156	49612	75905	68298	50288	50248
6+	29366	21018	12786	15441	21573	29135	44995	37942	27795
7+	12057	12426	5747	6018	8054	11056	15549	23474	20279

Table 12. Mid-year population biomass($tX10^{-3}$) of Subdivision 3Ps cod from a cohort run of F_t= 0.45.

POPULATION BIOMASS (MID-YEAR)

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	14935	14962	12870	12184	10772	17718	20238	21295	24602	17657	13673	8912	14876	[illegible]	[illegible]
4	62171	27962	28112	23502	22681	19452	31857	35383	38921	44449	32860	24593	16491	27471	13019
5	30960	60142	27576	28540	23209	23976	19164	29159	32109	37723	45028	31670	23132	14454	23520
6	30539	28466	46611	24347	25747	20254	23624	16431	22946	27259	33056	40880	28385	20721	11778
7	29335	24533	22422	32680	21017	21432	14660	17438	11926	16302	20545	25556	27853	19936	15617
8	15397	19981	13752	17728	23495	16631	16260	9312	10659	7890	10421	12608	12494	16219	9061
9	12353	12374	11295	5968	14398	15582	11720	9532	5941	7790	4401	6830	8465	8532	8049
10	12456	7794	6460	6397	3734	11066	9275	6536	5412	3663	4780	2396	3987	3974	3828
11	18097	7906	4200	2793	4434	1741	8175	4942	2777	3803	2395	2481	1560	1694	1197
12	5421	13964	5419	2297	1778	2511	576	5404	2987	1246	2564	1825	1398	775	922
13	972	2152	9442	3696	1251	1134	837	188	3252	2480	826	1502	1210	1107	347
14	0	618	812	5660	2516	670	668	288	64	1976	1762	206	878	685	366
3+	232637	220855	188970	165791	155032	152168	157074	155909	161595	172279	172030	157257	134323	119009	102659
4+	217702	205893	176101	153608	144260	134450	136837	134614	136993	154622	158357	146345	119447	109140	93240
5+	155531	177931	147989	130106	121579	114998	104980	99230	98072	110173	125478	123772	103766	81849	77152
6+	124571	117789	120412	101565	98371	91022	85815	70071	65764	72450	80450	92102	80834	67165	59564
7+	94032	89323	73801	77219	72623	70767	62192	53640	43018	45151	47393	51122	55439	46443	38807

AGE	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	10454	14159	14340	37946	15534	7700	17626	38466	5200
4	13170	17977	23728	24195	37783	17554	10441	20747	46384
5	15212	11177	15292	24658	24511	37817	20945	12846	21536
6	20715	8836	8139	12761	17624	22576	37171	19679	10435
7	6653	9803	4671	6382	8366	13323	16761	28336	13939
8	8961	3073	3768	3060	3591	6010	9051	9943	18784
9	3301	3557	1819	2631	1839	2385	4396	5289	5961
10	3011	1163	1470	1213	1590	1301	2018	2396	3297
11	1441	1167	831	1101	591	1090	937	1101	1332
12	346	559	594	562	837	452	744	580	613
13	113	98	352	387	321	754	254	347	269
14	181	15	56	311	168	231	452	115	228
3+	83559	71584	75058	115207	112756	111393	120796	139846	129968
4+	73105	57425	60719	77262	97222	103693	103171	101380	124768
5+	59935	39448	36991	53067	59439	86139	92729	80633	76384
6+	44724	28272	21699	28409	34927	48322	71784	67787	54848
7+	24009	19435	13560	15648	17303	25746	34613	48107	44413

Table 13. Fishing mortalities for Subdivision 3Ps cod from a cohort run at F_t= 0.45

FISHING MORTALITY

AGE	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
3	0.019	0.011	0.010	0.029	0.025	0.030	0.032	0.013	0.033	0.018	0.016	0.024	0.054	0.021	0.034	0.051	0.036	0.080
4	0.155	0.136	0.138	0.139	0.137	0.206	0.210	0.268	0.194	0.197	0.150	0.229	0.289	0.125	0.180	0.319	0.283	0.356
5	0.264	0.429	0.409	0.343	0.332	0.355	0.329	0.489	0.438	0.379	0.280	0.444	0.404	0.345	0.467	0.719	0.527	0.566
6	0.403	0.409	0.582	0.315	0.347	0.433	0.358	0.477	0.472	0.363	0.368	0.404	0.485	0.290	0.579	0.522	0.877	0.600
7	0.402	0.343	0.390	0.423	0.290	0.332	0.538	0.714	0.477	0.531	0.538	0.658	0.716	0.661	0.626	0.932	1.473	0.679
8	0.197	0.566	1.114	0.249	0.418	0.366	0.409	0.553	0.414	0.538	0.547	0.633	0.817	0.527	0.791	0.674	0.766	0.425
9	0.419	0.340	0.680	0.549	0.257	0.503	0.430	0.800	0.420	0.291	0.748	0.461	0.821	0.528	1.048	1.463	1.112	0.318
10	0.519	0.545	1.103	0.458	0.401	0.301	0.572	0.820	0.299	0.596	0.773	0.458	0.756	0.831	0.746	0.923	0.463	0.184
11	0.211	0.312	0.648	0.407	0.195	1.199	0.243	0.639	0.838	0.355	0.154	0.436	0.331	0.740	0.886	1.062	0.914	0.124
12	0.713	0.205	0.345	0.430	0.393	0.933	0.839	0.509	0.224	0.631	0.330	0.297	0.634	1.077	1.266	1.663	0.659	0.249
13	0.387	1.079	0.482	0.296	0.698	0.387	1.198	1.406	0.372	0.016	1.046	0.657	0.416	0.536	0.333	2.358	0.497	0.092
14	0.350	0.400	0.654	0.390	0.335	0.369	0.479	0.699	0.430	0.496	0.572	0.626	0.748	0.602	0.726	0.858	1.255	0.403

AGE	1977	1978	1979	1980	1981	1982
3	0.014	0.006	0.008	0.009	0.013	0.009
4	0.259	0.080	0.088	0.114	0.106	0.076
5	0.443	0.239	0.263	0.277	0.296	0.211
6	0.472	0.421	0.386	0.376	0.389	0.319
7	0.389	0.530	0.500	0.657	0.425	0.450
8	0.445	0.615	0.547	0.571	0.523	0.450
9	0.426	0.548	0.517	0.433	0.475	0.450
10	0.481	0.621	0.357	0.361	0.488	0.450
11	0.308	0.674	0.310	0.424	0.606	0.450
12	0.523	0.225	0.347	0.492	0.583	0.450
13	0.712	0.483	0.140	0.708	0.587	0.450
14	0.386	0.519	0.470	0.530	0.500	0.450

Table 14. Selectivity coefficient for Subdivision 3Ps cod from a cohort run at F_t= 0.45

SELECTIVITY COEFFICIENTS

AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
3	0.01	0.07	0.08	0.08	0.07	0.02	0.07	0.04	0.03	0.04	0.07	0.03	0.05	0.06	0.03	0.15	0.03	0.01	0.02	0.01	0.03	0.02
4	0.20	0.51	0.41	0.53	0.45	0.38	0.43	0.40	0.26	0.37	0.39	0.20	0.24	0.35	0.21	0.68	0.63	0.14	0.17	0.19	0.24	0.17
5	0.58	0.87	1.00	0.66	0.71	0.69	0.97	0.77	0.49	0.71	0.54	0.56	0.62	0.78	0.39	1.00	1.00	0.43	0.52	0.45	0.66	0.47
6	0.83	0.80	1.00	1.00	0.55	0.68	1.00	0.73	0.65	0.65	0.65	0.47	0.77	0.57	0.66	1.00	1.00	0.75	0.77	0.61	0.87	0.71
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 15. Catch at age of cod by the offshore fishery in Subdivision 3Ps along with the corresponding proportion at age of the total fishery for the period 1978-82. Estimates of offshore fishing mortality & resulting selectivity are also shown.

CATCH ('000)

AGE	1978	1979	1980	1981	1982
3	1	39	68	5	1
4	314	352	308	12	142
5	1074	2719	1137	45	270
6	1707	1359	2234	258	243
7	576	754	2072	259	345
8	252	294	445	148	295
9	39	95	78	28	59
10	32	16	1	7	18
11	12	1	1	4	10
12	3	1	1	4	1
13	4	1	1	1	1
14	1	1	1	1	1

PROPORTION

AGE	1978	1979	1980	1981	1982
3	0.005	0.262	0.228	0.005	0.010
4	0.073	0.149	0.137	0.004	0.030
5	0.199	0.278	0.223	0.016	0.067
6	0.406	0.383	0.288	0.081	0.130
7	0.322	0.291	0.472	0.182	0.139
8	0.345	0.333	0.313	0.074	0.171
9	0.160	0.335	0.223	0.049	0.186
10	0.169	0.125	0.010	0.034	0.164
11	0.158	0.021	0.019	0.045	0.103
12	0.115	0.053	0.024	0.108	0.121
13	0.211	0.091	0.053	0.042	0.071
14	0.100	0.100	0.040	0.167	0.111

FISHING MORTALITY

AGE	1978	1979	1980	1981	1982
3	0.000	0.002	0.002	0.000	0.000
4	0.006	0.013	0.021	0.000	0.002
5	0.048	0.073	0.062	0.005	0.015
6	0.171	0.137	0.101	0.024	0.041
7	0.170	0.146	0.310	0.022	0.058
8	0.212	0.182	0.179	0.049	0.045
9	0.088	0.173	0.397	0.023	0.039
10	0.105	0.070	0.003	0.017	0.039
11	0.106	0.006	0.008	0.027	0.046
12	0.026	0.018	0.012	0.063	0.014
13	0.097	0.013	0.037	0.024	0.032
14	0.052	0.047	0.021	0.083	0.050

SELECTIVITY

AGE	1978	1979	1980	1981	1982
3	0.00	0.01	0.01	0.00	0.00
4	0.03	0.09	0.08	0.02	0.05
5	0.25	0.48	0.24	0.17	0.30
6	1.00	0.91	0.40	0.86	0.84
7	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00

Table 16. Relationship of standard CPUE indices with 'offshore' exploitable biomass for subdivision 3Ps cod from cohort analyses at a range of Terminal F's. Residuals (observed-calculated) are indicated for recent years.

			Exploitable Biomass ($X10^{-3}t$) at F_t							
			.35		.40		.45		.50	
Year	CPUE	Observed	Residuals	O.	R.	O.	R.	O.	R.
1961	2.256	134							
1962	1.770	134							
1963	2.259	132							
1964	1.996	118							
1965	2.081	105							
1966	2.320	99							
1967	1.917	115							
1968	2.389	112							
1969	2.354	100							
1970	1.979	110							
1971	1.981	92							
1972	1.492	70							
1973	1.424	69							
1974	1.034	53							
1975	.976	34	-19.55	34	-17.53	34	-15.95	34	-14.70
1976	1.046	56	-.99	56	.61	55	1.85	55	2.85
1977	1.000	71	16.59	70	17.75	70	18.66	69	19.38
1978	1.194	45	-19.60	44	-18.73	43	-18.06	43	-17.52
1979	1.289	70	1.23	68	.51	66	-.05	65	-.49
1980	1.054	61	3.73	58	2.55	56	1.63	54	.89
1981	1.315	80	9.99	74	4.64	68	.48	64	-2.85
1982	1.585	80	-4.50	70	-13.20	62	-19.96	56	-25.38
Intercept		4.56		1.086		-1.612		-3.769	
Slope		50.15		51.555		52.648		53.52	
r^2		.721		.729		.730		.726	

Table. 17. Catch rates from Can(N) OT- 5 for cod directed catches in Subdivision 3 Ps. (catch indicated in brackets).

	1981	1982	1983[a]
Jan.	1.02(1148)	0.30(8)	1.14(261)
Feb.	0.60(21)	1.64(228)	2.75(22)
Mar.	0.24(11)	0.46(35)	0.84(252)
1st. Qtr.	0.97(1180)	1.12(271)	0.99(535)

a preliminary

Table 19. Relationship of survey mean numbers per tow at ages 2 and 3 with cohort numbers at age (F_T=0.45) for cod in Subdivision 3Ps

Year-class	Age 2	Age 3	Cohort No. at Age 3 ($\times 10^{-3}$)	Predicted cohort age 3 from survey age 2	Predicted cohort age 3 from survey age 3	Average
1980	2.35			43		
1979	1.50	.61		38	20	29
1978	9.57	5.94	89	87	74	80
1977	1.89	3.22	38			
1976	1.06	1.40	21			
1975	.26	.88	38			
1974	5.35	4.57	77			
1973	1.72	3.30	59			
1972	6.45	5.18	57			
1971	3.96	4.70	42			
1970	1.83	2.39	31			
1969		3.35	39			
r^2	.69	.61				
int.	28.67	13.78				
slope	6.05	10.11				

Table 19. Input data - 3Ps cod projections

Age	Population No. 1982 X10^{-3}	Catch 1982 X10^{-3}	Partial Selection	Average Weight (kg) 1980-82
3	30000	10+	0.02	0.+8
+	7192+	+807	0.17	0.76
5	22+53	3393	0.+7	1.21
6	7516	1873	0.71	1.75
7	3027	2556	1.00	2.38
8	8870	2935	1.00	3.25
9	2073	636	1.00	+.56
10	8+9	281	1.00	5.97
11	293	97	1.00	6.96
12	97	32	1.00	8.77
13	+2	1+	1.00	8.79
1+	27	9	1.00	10.18

from 1980-82.

POPULATION NUMBERS ($X10^{-3}$)

	1982	1983	1984	1985	1986
3	30000	45000	55000	55000	55000
4	71924	24468	36564	44850	44850
5	22453	54550	18781	28936	35493
6	7516	14879	37365	13997	21565
7	8027	4471	9304	26542	9943
8	8870	4191	2504	6237	17792
9	2073	4631	2347	1679	4181
10	849	1082	2594	1574	1125
11	293	443	606	1739	1055
12	97	153	248	406	1166
13	42	51	86	166	272
14	27	22	28	57	112
3+	152171	153939	165429	181184	192553
4+	122171	108939	110429	126184	137553
5+	50247	84471	73865	81333	92703
6+	27794	29921	55084	52398	57210

POPULATION BIOMASS (AVERAGE) (T)

	1982	1983	1984	1985	1986
3	13027.24	19505.44	23881.34	23881.34	23881.34
4	47756.16	16339.49	24777.01	30391.92	30391.92
5	22272.24	54954.57	19689.20	30334.69	37209.07
6	10258.57	20779.90	55380.70	20745.63	31962.30
7	14047.72	8075.43	18251.39	52065.62	19503.80
8	21197.28	10336.53	6708.24	16706.47	47658.43
9	6950.68	16025.86	8822.52	6309.17	15712.61
10	3726.72	4903.25	12763.42	7742.56	5536.86
11	1499.32	2340.91	3477.40	9974.34	6050.64
12	626.00	1017.83	1794.37	2937.16	8424.74
13	270.96	338.40	620.59	1205.55	1973.33
14	201.73	168.70	238.41	481.77	935.89
3+	141834.57	154786.30	176404.59	202776.21	229240.93
4+	128807.33	135280.86	152523.25	178894.87	205359.59
5+	81051.23	118941.37	127746.24	148502.95	174967.67
6+	58778.98	63986.81	108057.04	118168.26	137758.60

Table 21. Catch biomass and fishing mortality for cod in Subdiv. 3Ps from a projection using average weights at age from 1980-82.

CATCH BIOMASS (T)

	1982	1983	1984	1985	1986
3	50	148	96	96	96
4	3653	1054	842	1033	1033
5	4711	9802	1851	2351	3499
6	3278	5509	7864	2946	4539
7	6321	3065	3650	10413	3901
8	9539	3923	1342	3341	9532
9	3128	6082	1765	1262	3143
10	1678	1261	2553	1549	1107
11	675	389	595	1995	1210
12	281	386	359	597	1585
13	123	128	124	241	395
14	92	64	48	96	197
3+	33528	33000	21188	26411	30324
4+	33478	32852	21093	26315	30229
5+	29824	31799	20250	25282	29196
6+	25114	21996	19399	22930	25699

MEAN WEIGHT OF INDIVIDUALS IN CATCH

	1982	1983	1984	1985	1986
	1.9	1.9	2.1	2.2	2.3

FISHING MORTALITY

	1982	1983	1984	1985	1986
3	0.004	0.008	0.004	0.004	0.004
4	0.076	0.065	0.034	0.034	0.034
5	0.211	0.179	0.094	0.094	0.094
6	0.320	0.259	0.142	0.142	0.142
7	0.450	0.379	0.200	0.200	0.200
8	0.450	0.379	0.200	0.200	0.200
9	0.450	0.379	0.200	0.200	0.200
10	0.450	0.379	0.200	0.200	0.200
11	0.450	0.379	0.200	0.200	0.200
12	0.448	0.379	0.200	0.200	0.200
13	0.445	0.379	0.200	0.200	0.200
14	0.445	0.379	0.200	0.200	0.200
3+	0.144	0.139	0.073	0.078	0.079

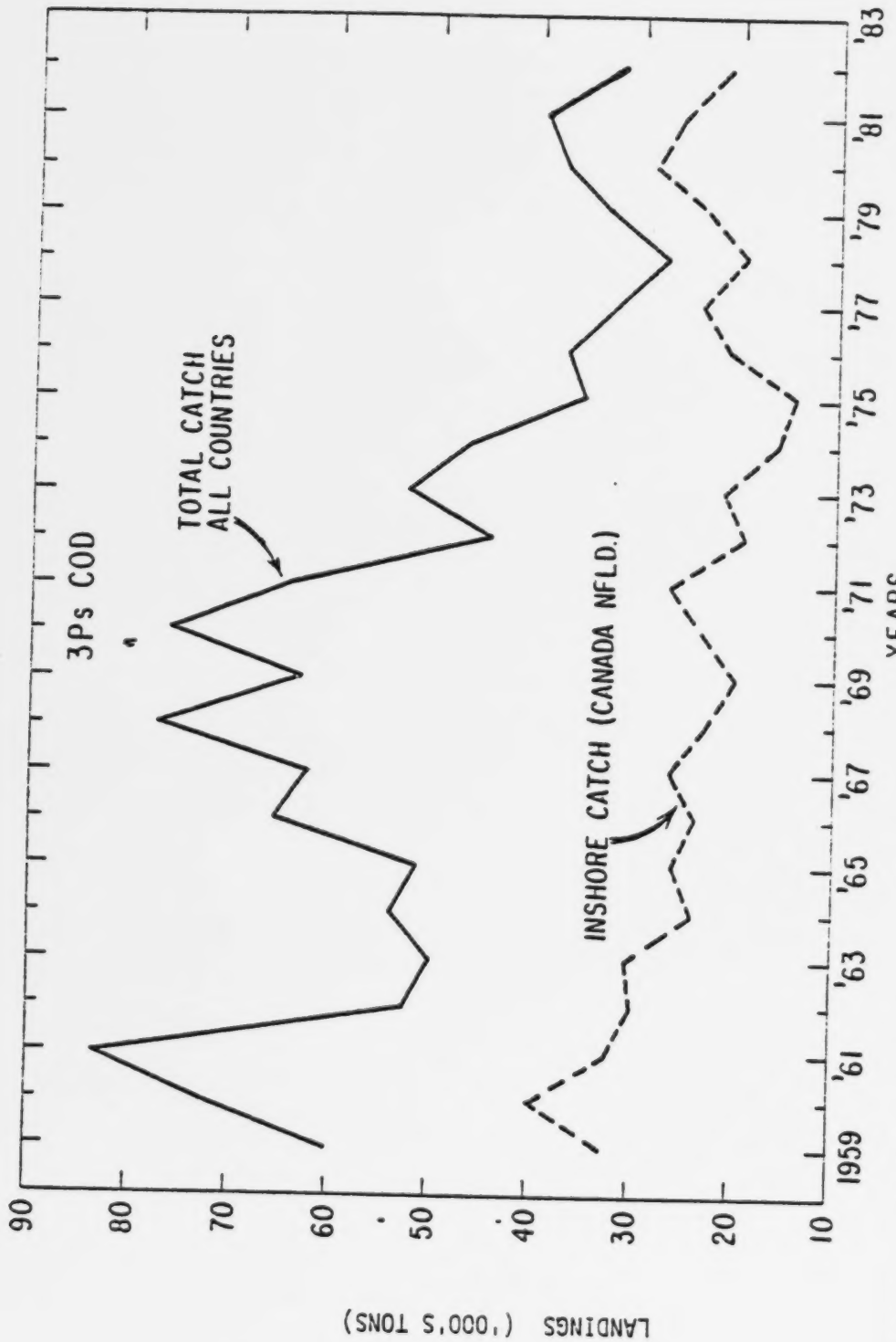


Fig. 1. Total catch of 3Ps cod by all countries along with inshore catch for Can(N) for the period 1959-82.

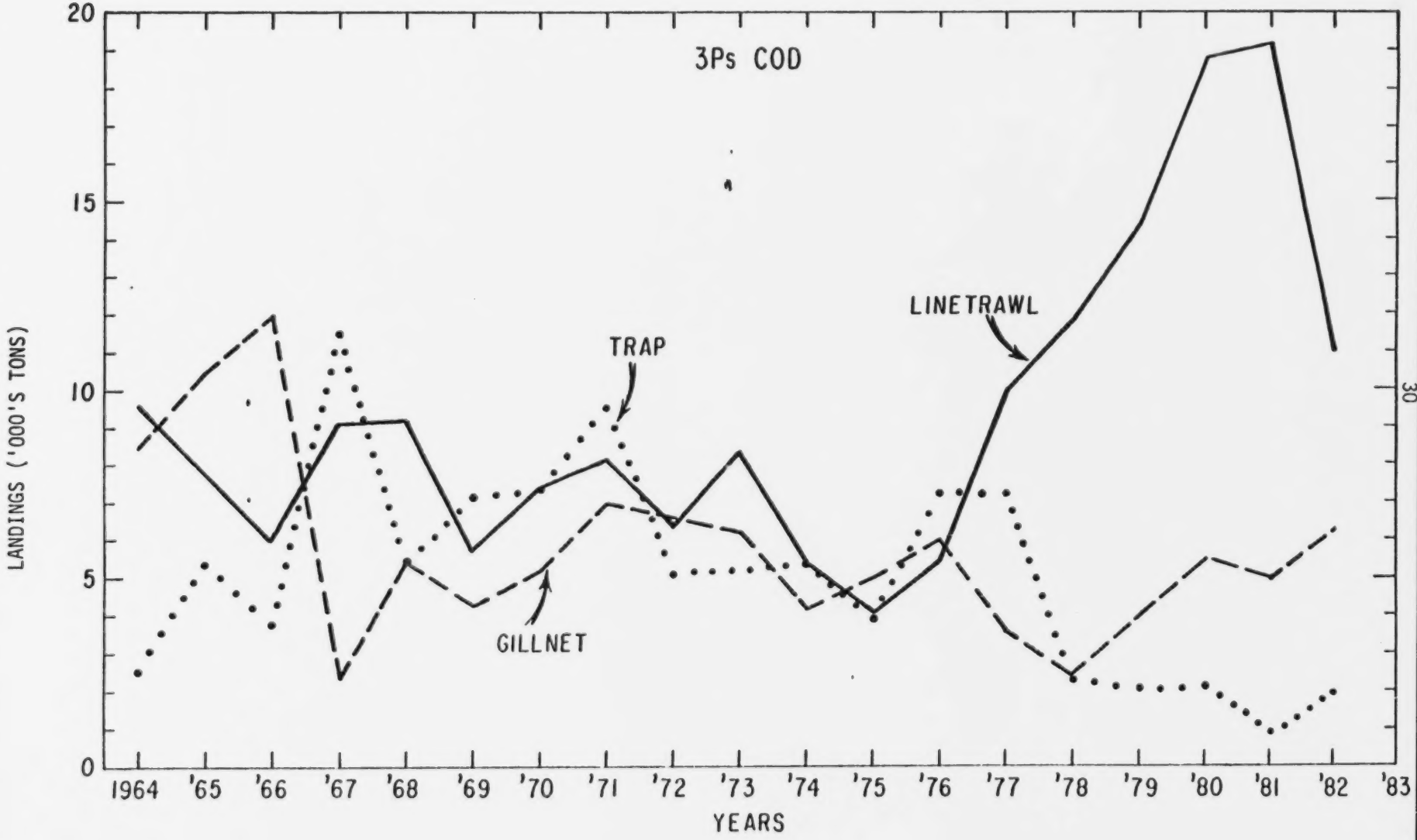


Fig. 2. Inshore Can(N) cod catch by gear in Subdivision 3Ps for the period 1964-82.

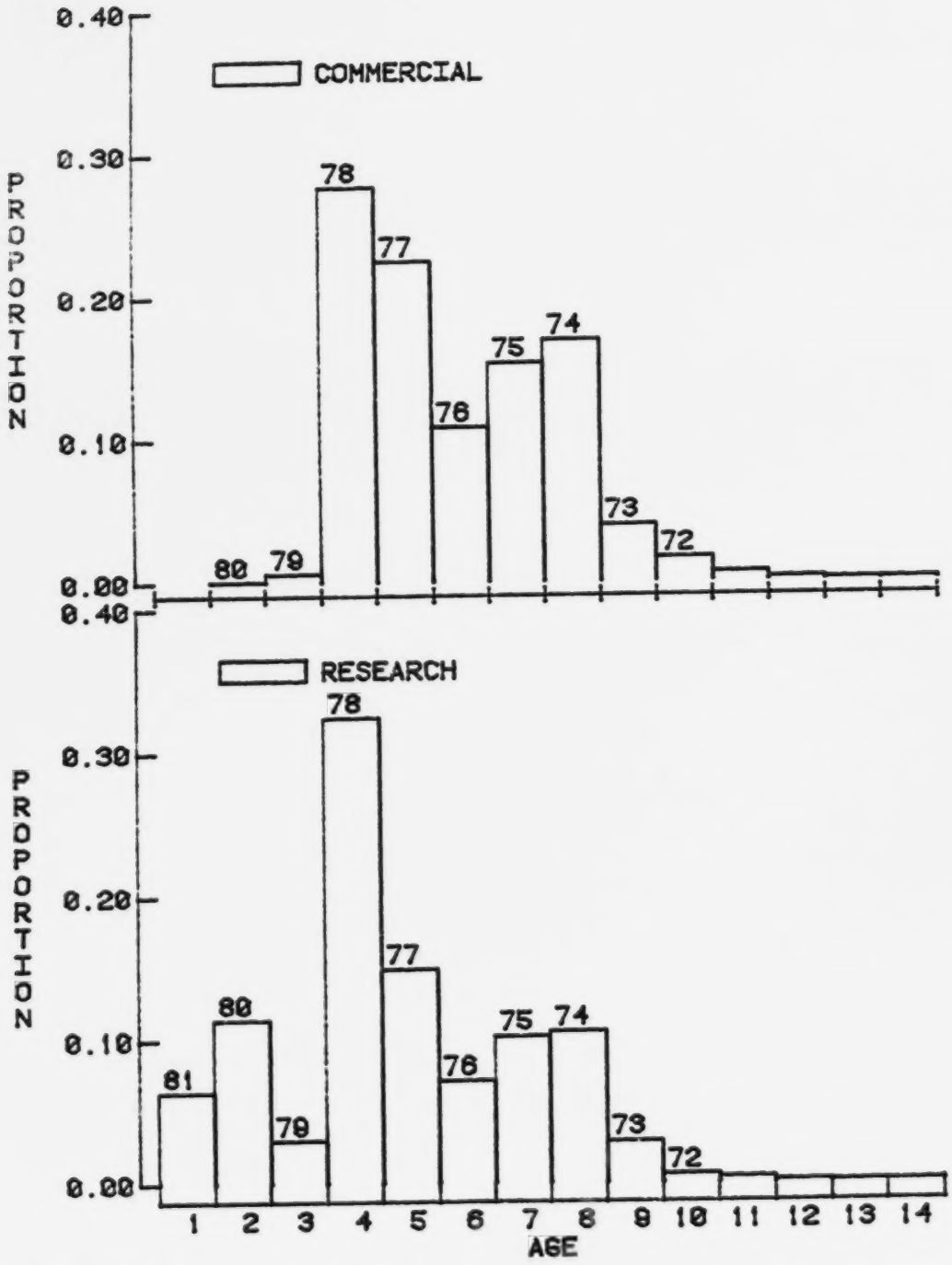


Fig. 3. Proportions at age and by year class from the commercial fishery and a Research vessel cruise for cod in Subdivision 3Ps during 1982.

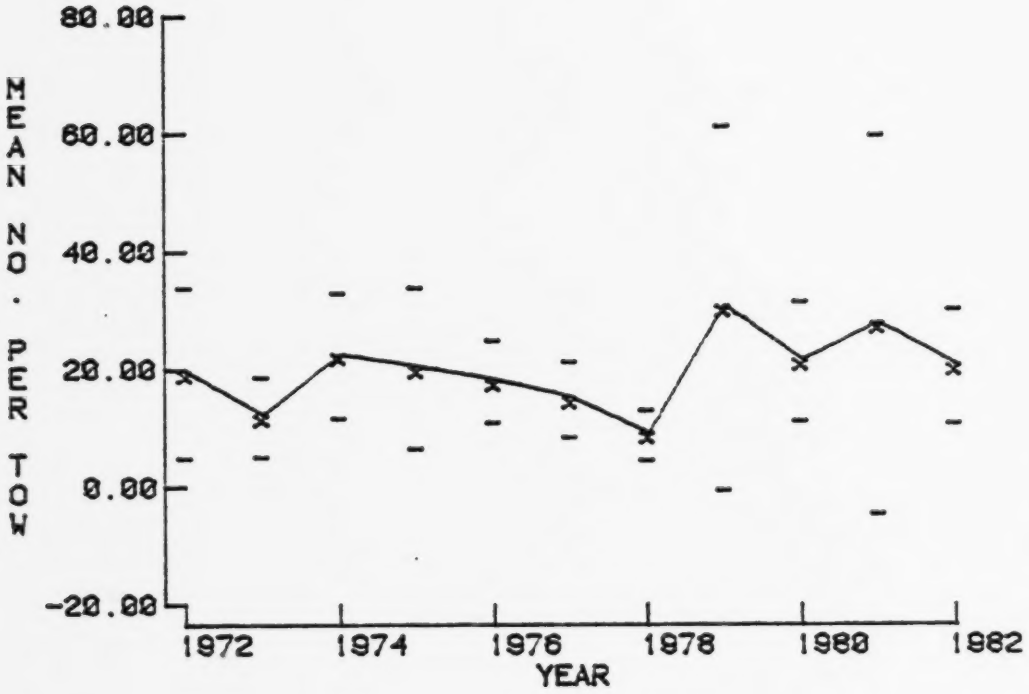


Fig. 4. Mean number of cod per tow from research trips in Subdivision 3Ps with associated confidence limits.

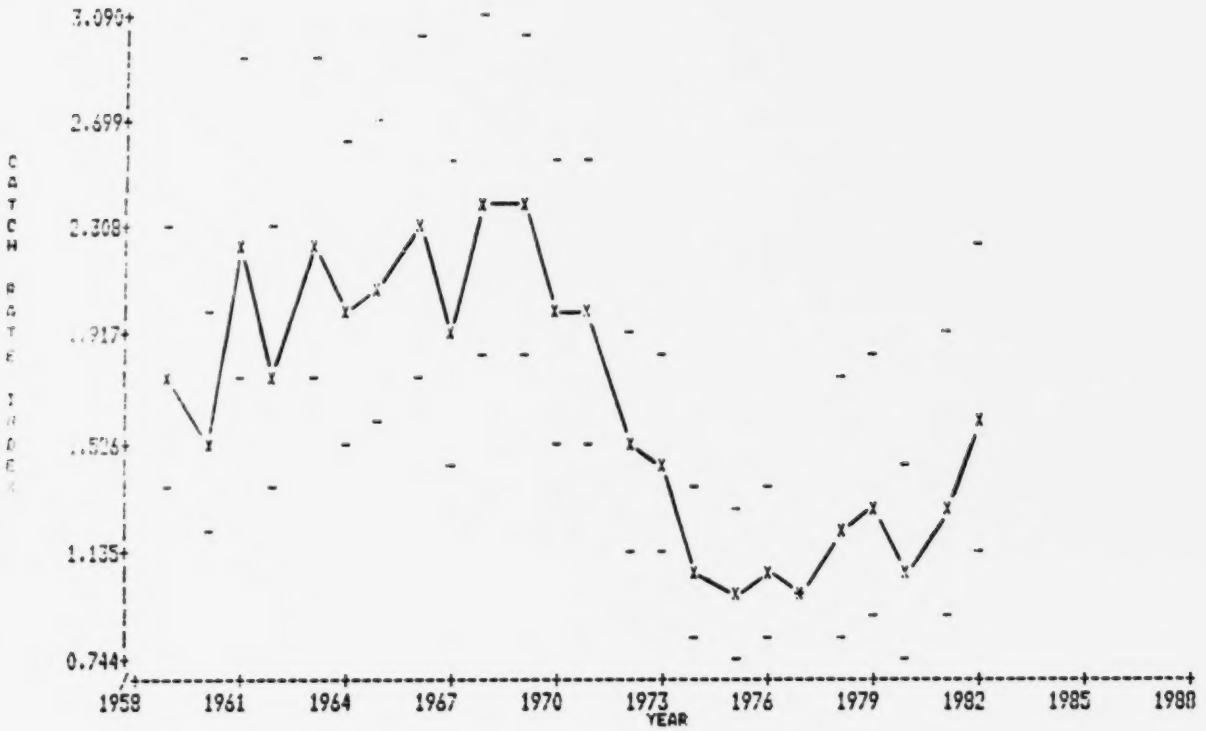


Fig. 5. Historical catch rate indices relative to 1977 for cod in Subdivision 3Ps with approximate 90% confidence intervals.

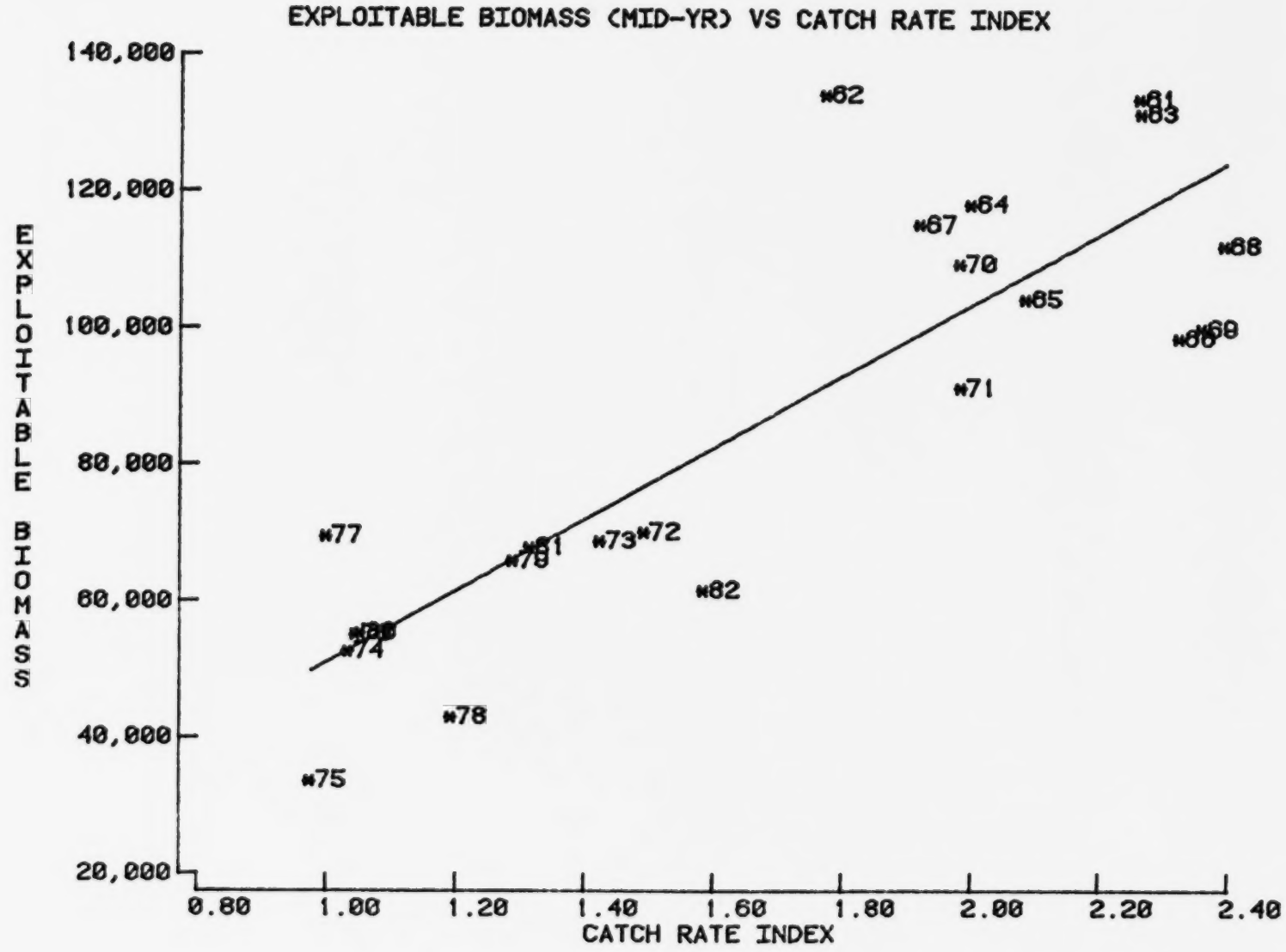
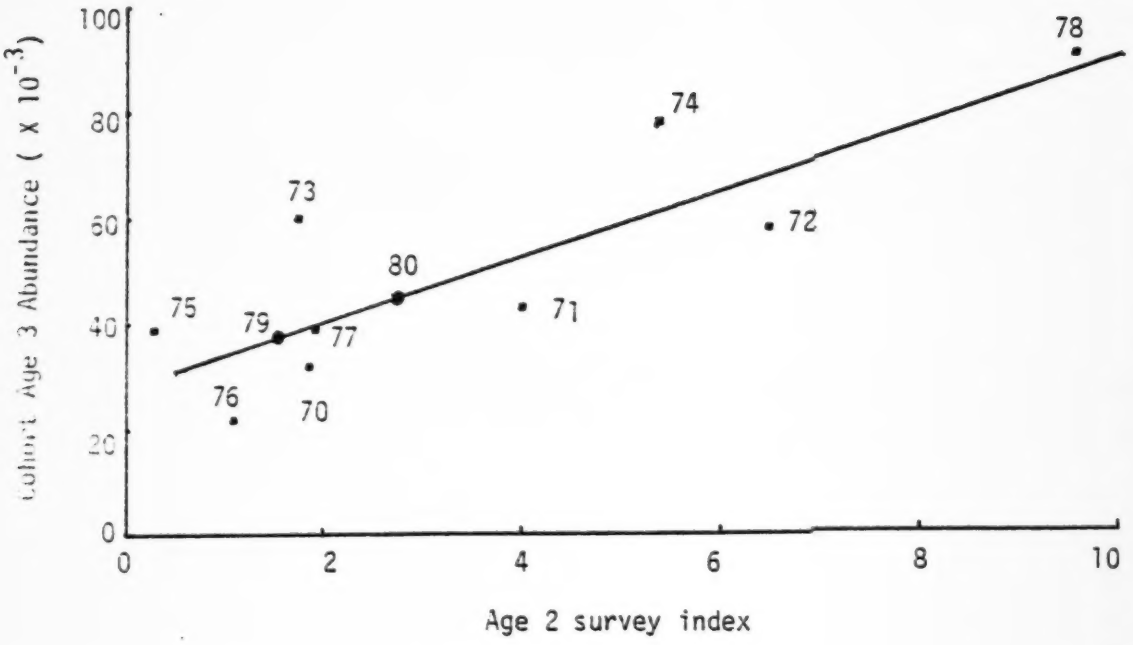


Fig. 6. Relationship of cohort exploitable 'offshore' biomass (F_t = 0.45) with standard CPUE indices for the period 1961-82 for Subdivision 3Ps cod.



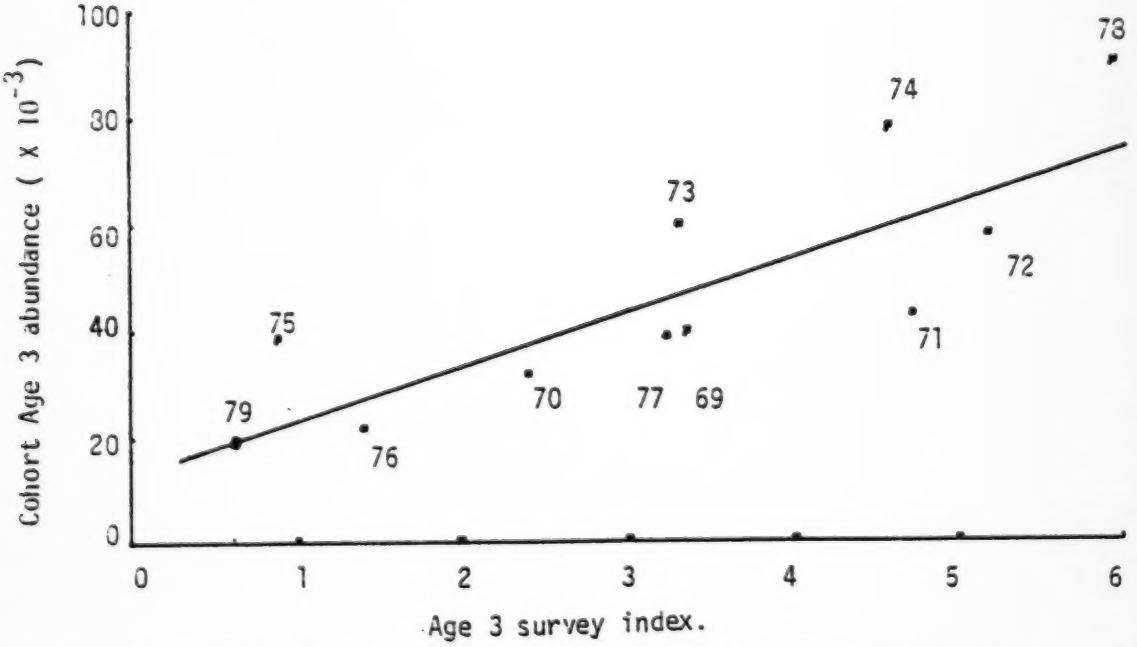


Fig. 7. Comparison of survey mean number per tow at ages 2 and 3 with cohort population numbers at age 3 (F_t = 0.45)

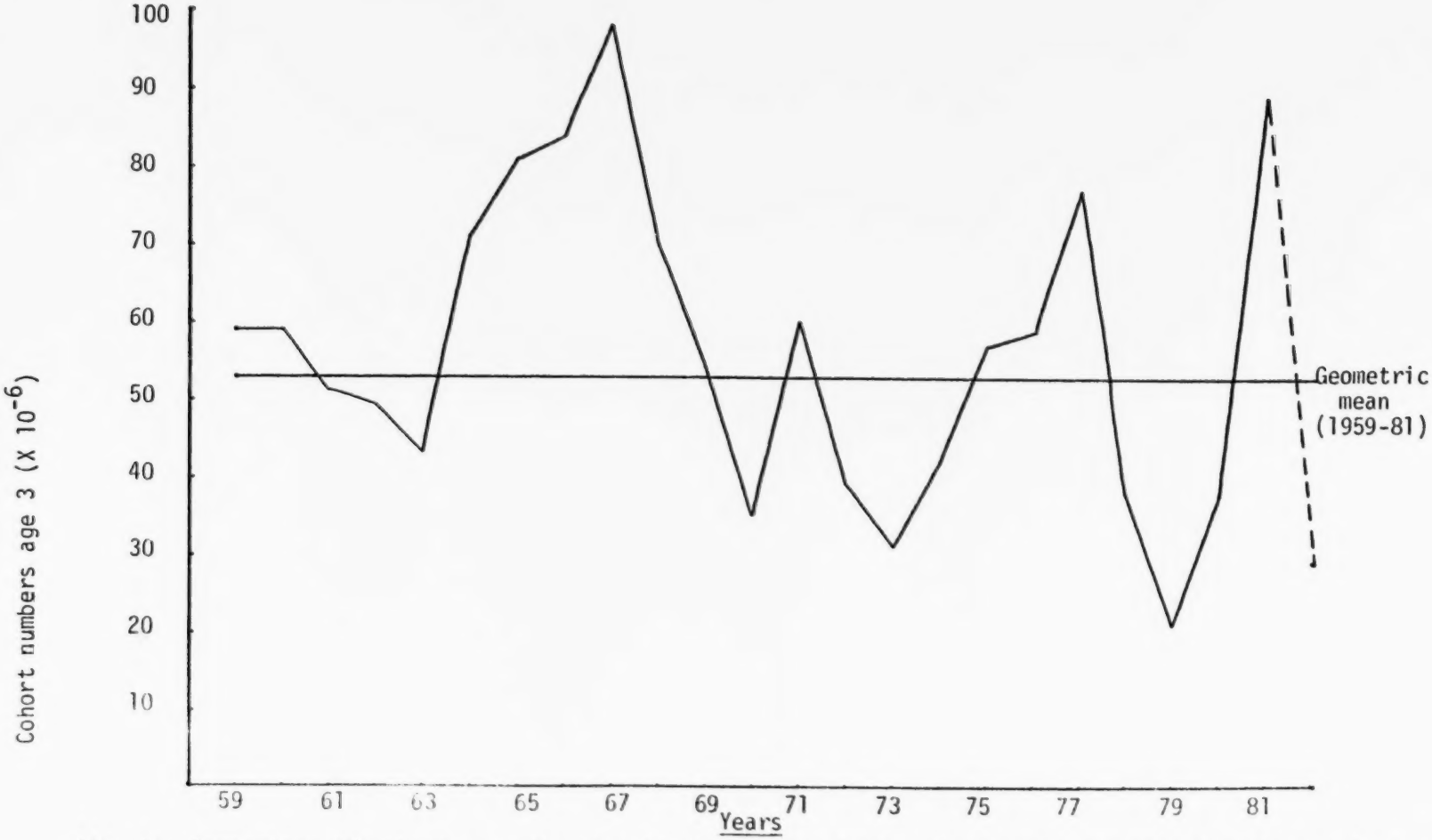


Fig. 8. Comparison of cohort recruitment estimates at age 3 with their geometric mean for 3Ps cod from 1959-81. An estimate for the 1982 value is included.